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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte WAI-FAN YAU, DAVID CHEUNG, SHIN-PUU JENG,
KUOWEI LIU, YUNG-CHENG YU

Appeal 2009-013636
Application 10/756,122
Technology Center 2800

Before ROMULO H. DELMENDO, SCOTT R. BOALICK, and JEFFREY
B. ROBERTSON, *Administrative Patent Judges*.

ROBERTSON, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Appellants seek our review under 35 U.S.C. § 134 of the Examiner's final decision rejecting claims 15-18, 21-25, 27, and 28. We have jurisdiction pursuant to 35 U.S.C. § 6(b).

We AFFIRM.

THE INVENTION

Appellants' invention relates to the fabrication of integrated circuits, and particularly to a process and apparatus for depositing dielectric layers on a semiconductor substrate. (Spec. [0002].)

Claim 15, reproduced below, is representative of the subject matter on appeal.

15. A method comprising depositing on a substrate a plurality of layers, wherein one or more of the layers is a low dielectric constant oxidized organosilane layer comprising carbon, wherein the low dielectric constant oxidized organosilane layer is deposited in a plasma enhanced process from a mixture comprising a methylsilane compound and an oxidizing gas, the carbon content of the low dielectric constant oxidized organosilane layer is from 1% to 50% by atomic weight, and a top layer of the plurality of layers is a photoresist.

THE REJECTIONS

The prior art relied upon by the Examiner in rejecting the claims on appeal is:

Chiang	US 5,817,572	Oct. 6, 1998
Matsuura	US 6,124,641	Sep. 26, 2000
Hu	US 5,718,967	Feb. 17, 1998
Chen	US 5,970,376	Oct. 19, 1999

Wolf et al., Silicon Processing for the VLSI Era, Volume 1: Process Technology, Lattice Press, 1986.

Appellants appeal the following grounds of rejection:

I. The Examiner rejected claims 15-18, 21, 23-25, 27, and 28 under 35 U.S.C. § 103(a) as being unpatentable over Chiang et al. in view of Matsuura and Hu.

II. The Examiner rejected claim 22 under 35 U.S.C. § 103(a) as being unpatentable over Chiang in view of Matsuura and Hu and further in view of Chen.

ISSUES

In rejecting the claims on appeal, the Examiner relied on Chiang in view of Matsuura for the method of depositing a plurality of layers, and relied specifically on Matsuura for the particular oxidized organosilane layer comprising carbon and having a low dielectric constant recited in the claims. (Ans. 3-5.) The Examiner acknowledged that while Matsuura discloses a chemical vapor deposition process for depositing the oxidized organosilane, Matsuura does not disclose the recited plasma enhanced chemical vapor deposition process recited in the claims. (Ans. 4-5.) The Examiner found that Hu disclosed a method of forming oxidized organosilane layers by plasma enhanced chemical vapor deposition. (Ans. 5-6.) The Examiner concluded that it would have been obvious to use the process of Hu in depositing the oxidized organosilane of Matsuura as an alternative method to perform the chemical vapor deposition step. (Ans. 6.)

Appellants argue that Hu provides no indication that plasma could be used in the chemical vapor deposition (“CVD”) process taught by Matsuura. (App. Br. 12; Reply Br. 3.) Appellants contend that to deposit a film containing carbon from Matsuura’s precursors, “it is necessary to leave some silicon-carbon bonds undisturbed.” (App. Br. 13.) Appellants argue that it would not have been obvious that applying plasma to the Matsuura process would preserve any carbon in the deposited film. (App. Br. 13.) Appellants contend that a skilled artisan would understand that due to the reactivity of the silicon-carbon bond in methylsilane, the most likely result of using the Hu plasma process in Matsuura is deposition of a silicon oxide layer devoid of carbon. (App. Br. 13.)

Appellants additionally contend that neither Hu nor Matsuura discloses a low-k dielectric layer. (App. Br. 12-13.)

In light of Appellants’ contentions, the dispositive issue is:

Did the Examiner err in determining, in viewing the evidence of record as a whole, that it would it have been obvious to modify the process of Chiang in view of Matsuura to use plasma enhanced chemical vapor deposition as disclosed in Hu to deposit a low dielectric constant oxidized organosilane layer comprising carbon from a mixture comprising a methylsilane compound and an oxidizing gas?

FINDINGS OF FACT

The record supports the following findings of fact (FF) by a preponderance of the evidence.

1. Matsuura discloses a “silicon oxide film formed by a CVD method using [an] organic silane, such as methylsilane[,] and hydrogen peroxide (H₂O₂).” (Col. 2, ll. 60-63.)
2. An objective of the Matsuura invention is to “reduce the relative dielectric constant” of a silicon oxide film. (Col. 2, ll. 58-60.)
3. Hu discloses a silicon oxide layer, which may contain hydrogen and carbon atoms, formed by a PECVD method, using an organosilicon compound and an oxidizing gas (oxygen). (Col. 3, ll. 19-21, 26-27, 43-60.)
4. Hu states: “[e]xamples of silanes include dimethoxydimethylsilane” (Col. 3, ll. 45-46.)
5. Hu discloses varying the stoichiometric amount of oxygen relative to the organosilicon compound such that the process is insufficient to oxidize all the silicon and carbon in the organosilicon compound. (col. 2, ll. 53-60.)
6. Wolf discloses that PECVD uses an rf-induced glow discharge to transfer energy into the reactant gases, such that energy to a PECVD reaction is partially supplied by a plasma, allowing the substrate to remain at a lower temperature than in CVD processes. (Wolf at 166-67, 171.)

PRINCIPLES OF LAW

In *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398 (2007), the Supreme Court explained that “Section 103 forbids issuance of a patent when ‘the

differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.’” *KSR*, 550 U.S. at 406.

The *KSR* Court further noted that:

When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, §103 likely bars its patentability. For the same reason, if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.

KSR, 550 U.S. at 417.

In responding to a *prima facie* case of obviousness, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. *In re Keller*, 642 F.2d 413, 426 (CCPA 1981); *In re Merck & Co., Inc.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986).

ANALYSIS and CONCLUSIONS

Appellants have not separately argued the claims subject to Rejection I. (App. Br. 10-13.) Accordingly, we confine our discussion to appealed claim 15, which contains claim limitations representative of the arguments made by Appellants pursuant to 37 C.F.R. § 41.37(c)(1)(vii). Regarding Rejection II, Appellants have not presented separate arguments, but instead

rely on the arguments presented for Rejection I. (App. Br. 14; Reply Br. 4.) Therefore, our comments regarding Rejection I apply equally to Rejection II.

We are unpersuaded by Appellants' argument that one of ordinary skill in the art would not have expected that depositing a low dielectric constant oxidized layer by a PECVD process from a mixture comprising a methylsilane compound and an oxidizing gas would deposit carbon on a film. Matsuura teaches a low dielectric constant oxidized organosilane layer deposited by a CVD process from a mixture comprising a methylsilane compound and an oxidizing gas. (Ans. 4, 9; FF 1.) Further, Hu discloses a silicon oxide layer, which includes hydrogen and carbon atoms, deposited by a PECVD process from a mixture comprising a methylsilane compound and an oxidizing gas. (Ans. 5-6, 9; FF 3, 4.) Indeed, Hu additionally discloses that by varying the amount of oxidizing gas present, the amount of unoxidized silicon and carbon may be controlled. (FF 5.)

We agree with the Examiner that one of ordinary skill in the art would have looked to Hu, which teaches alternative suitable or useful deposition methods. (Ans. 6.) *See also KSR*, 550 U.S. at 417. In this case, the alternative suitable and useful method is a PECVD process that reduces the energy required for a chemical reaction to take place and allows the temperature of the substrate to remain lower. (Ans. 10; FF 6.) In addition, Appellants have not presented any evidence that using a PECVD process in the instant invention was beyond the skill level of one of ordinary skill in the art.

Moreover, Appellants' argument (App. Br. 12-13; Reply Br. 3) that neither Hu nor Matsuura teaches a low dielectric constant layer that can be

deposited using a plasma process is not consistent with the evidence of record and unduly focuses on the references individually, rather than what the prior art as a whole would convey to one of ordinary skill in the art. *See In re Keller*, 642 F.2d at 426. Specifically, the Examiner does not rely on Hu for disclosing a low dielectric constant layer. (Ans. 5-6.) In addition, contrary to Appellants' arguments (App. Br. 13), Matsuura, discloses that such oxidized organosilanes have a low dielectric constant. (Ans. 8; FF 2.) Accordingly, when viewed as a whole, the combination of Chiang, Matsuura, and Hu discloses low dielectric constant layers.

Appellants' additional argument that the "Examiner does not explain why Matsuura is aware that layers adjacent to the dielectric layer may be deposited using plasma CVD but chooses not to disclose using plasma for depositing the dielectric layer from methylsilane and peroxide" (Reply Br. 2.) is without merit. Matsuura does not disclose that CVD is absolutely critical. Nor does it criticize or otherwise teach away from the use of PECVD in order to deposit the dielectric layer. Thus, the mere fact that Matsuura does not specify PECVD in depositing the dielectric layer while using PECVD to deposit other layers is not dispositive on the issue of whether a person of ordinary skill in the art would have reasonably expected PECVD to work for the dielectric layer.

In conclusion, the Examiner did not err in determining that it would have been obvious to modify the process of Chiang in view of Matsuura to use plasma enhanced chemical vapor deposition as disclosed in Hu to deposit a low dielectric constant oxidized organosilane layer comprising carbon from a mixture comprising a methylsilane compound and an

oxidizing gas. Accordingly, we affirm the Examiner's decision to reject claims 15-18, 21, 23-25, 27, and 28 under 35 U.S.C. § 103(a) (Rejection I).

As addressed above, Appellants do not offer any additional arguments for Rejection II. Therefore, we affirm Rejection II for the same reasons.

ORDER

We affirm the Examiner's decision rejecting claims 15-18, 21-25, 27, and 28.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. §1.136(a)(1)(v).

AFFIRMED

cu/rvb